Space Weather Technical Forecast

Issued on Friday, 15 March 2024 at 01:05 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Slight chance of M-flares (R1/R2 Radio Blackouts) Day 1.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Activity has been Moderate, with a peak flare of M1.0 observed at 14/0604 UTC from Ex-AR3599. There are currently six numbered regions on the visible disc. AR3599 departed the disc earlier on 14 Mar. The largest region on the disc is AR3607 in the southeast. It is moderately sized but relatively stable. Two new regions have emerged, with one Csi/Beta region in the northwest. Two other small regions have faded to plage. The remaining spots are small and simple.

There were no Earth-directed CMEs observed in the past 24 hours.

Solar Wind / Geomagnetic Activity: Solar wind speeds observed at L1 by DSCOVR have remained slightly elevated throughout, initially around 450-480km/s. Winds are on a gradual declining trend and are currently around 430 km/s. The solar wind density was generally average. The Interplanetary Magnetic Field (IMF), Bt, has been mostly weak, but with a peak of 9nT at 14/0400 UTC. The north south component, Bz, has weakly fluctuated between +7nT and -4nT. Bz has been mostly positive, although there has been a sustained period of weakly negative Bz since 14/2100 UTC. The phi angle was mostly positive (away from the Sun). Geomagnetic activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux remained at background.

High energy electron flux (greater than 2MeV) observed at GOES16 was at background, with a diurnal peak of moderate levels at 237pfu at 14/1725UTC. The observed 24-hour fluence showed a declining trend, with the 24-hour integrated fluence value at 15/0000 UTC being 3.82e6 integrated pfu.

Four-Day Space Weather Forecast Summary
Solar Activity: There is a slight chance of M-class flares on Day 1 (15 Mar), most likely from Ex-AR3599 on Day 1 (15 Mar). New or returning regions rotating onto the disc late Day 2 or Day 3 (16-17 Mar) contribute to an increased flare risk later in the period, but this is low confidence.

Solar Wind / Geomagnetic Activity: A single CME remains in the forecast at the start of Day 1, that of the M7.4 on 10 March, which has been assessed as a likely miss. There is very low confidence of a slight interaction early on Day 1 (15 Mar) with this risk readily diminishing. A weak connection to a high speed stream from CH09/+ may be the cause of the current slightly elevated winds. Confidence is low for solar wind speeds through the period, with a return to a slow wind regime favoured. However, interaction with a small negative polarity coronal hole, CH10/-, may result in slight enhancement from late on Day 2 or Day 3 (16-17 Mar).
Mostly Quiet or Unsettled (Kp 0-3) conditions are expected over the period, with a slight chance of an Active (Kp 4) interval should a pronounced connection to CH10/- occur.

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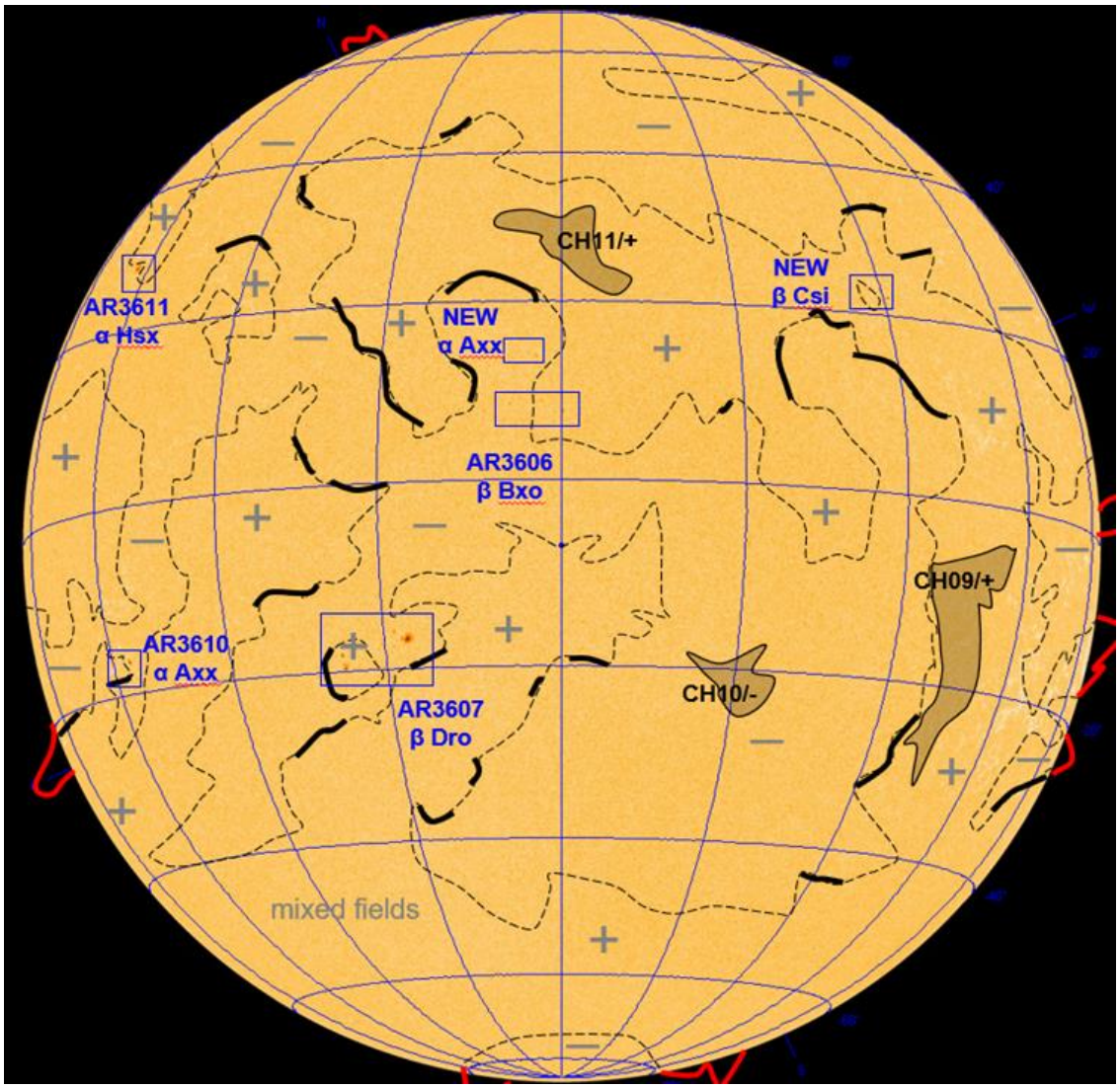
Energetic Particles / Solar Radiation: High energy electron flux (greater than 2MeV) has shown a decreasing trend, with diurnal Moderate levels falling back to background at minima. This trend is expected to continue given the absence of enhancements expected during the forecast period.

24-hr integrated fluence is likely to remain below the Active threshold throughout.

Figure 1. Solar Analysis Valid 14/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A CME associated with the M7.4 flare on 10/1230 UTC was expected to pass largely above and ahead of the track of the Earth in its orbit 13-14 Mar, and is now assessed as a likely miss. There remains a very low probability of a slight interaction with Earth in the early hours of Day 1 (15 Mar).

No other Earth-directed CMEs are in the current forecast, with the filament lift-off at 14/0820 UTC projected by Enlil to miss.

Confidence in the solar wind forecast is relatively low, with only minimal persistence of coronal hole features when compared to the previous rotation. The slightly elevated winds currently observed are thought to emanate from a weak, but waning, connection to a high speed stream from CH09/+. The small negative polarity coronal hole, CH10/- will rotate into a more geoeffective position during the period, with onset of any weak connection to a HSS possible from late on Day 2 or during Day 3 (16-17 Mar) but this is low confidence at this point. MOSWOC Enlil ensemble and SWPM support a return to a slow wind regime through Day 1 with no signal for any HSS enhancement through the period.

There are a number of filaments on the visible disc which, should they lift-off, may produce CMEs. These filaments are another source of uncertainty in the Geomagnetic forecast.
Mostly Quiet or Unsettled (Kp 0-3) conditions are expected over the period, with a slight chance of an Active (Kp 4) interval should a pronounced connection to the CH10/- HSS occur.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	5	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil Earth-directed CMEs are expected

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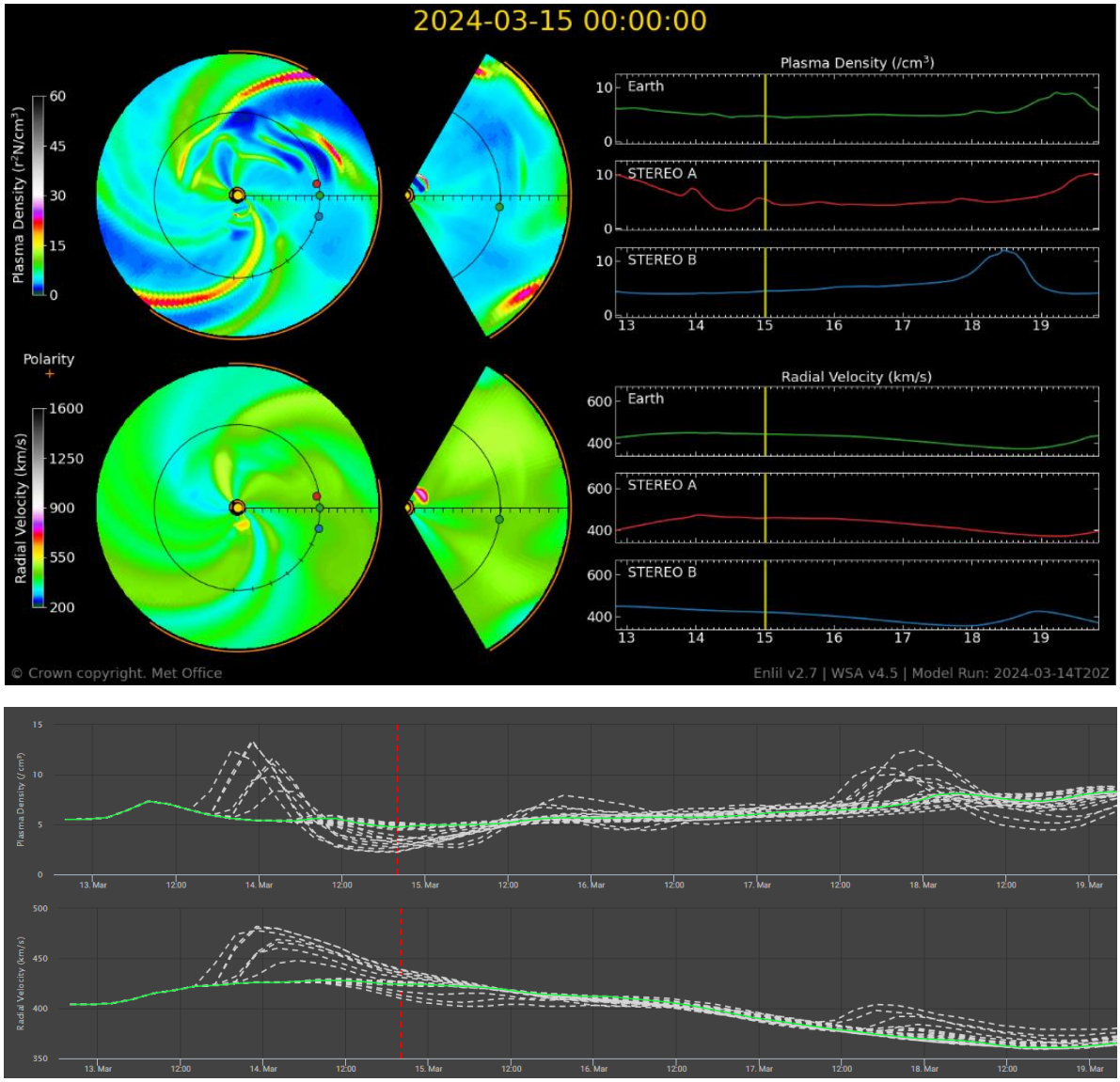
Figure 2: MOSWOC Enlil and Ensemble



Radio Blackouts - X-Ray Flares:

There are currently six numbered regions on the visible disc, two of which are unnumbered. AR3599 rotated out of view around the southwest limb earlier 14 Mar. AR3607 (Dso/Beta) is currently the largest region on the disc. A moderately sized spot but remains stable at present. A NEW Csi/Beta region has emerged on the northwest disc since last analysis; although small, it is one of the more significant regions on the disc. Another NEW region lies just to the north of AR3606, and although currently faint, exhibited signs of development and decline through 14 Mar. AR3608 and AR3609 have faded to plage. The remaining spots are small and simple.

Ex-AR3599 continues to contribute to the X-ray flare forecast through Day 1 (15 Mar) before it rotates sufficiently beyond the western limb to lose influence. Bright regions close to the east limb on SDO/AIA-0094 imagery indicates the approach of new or returning regions. Helioseismology suggests that one small region may rotate onto the disc during Day 1, however there seems insufficient evidence for this. A further more significant region is projected to rotate onto the disc late Day 2 or Day 3 (16-17 Mar); this may be Ex-AR3590, which was the source of several Strong flares on the previous rotation. The return of this region is reflected by the slight increase in flare probabilities later in the period, however confidence in flare probabilities is low.

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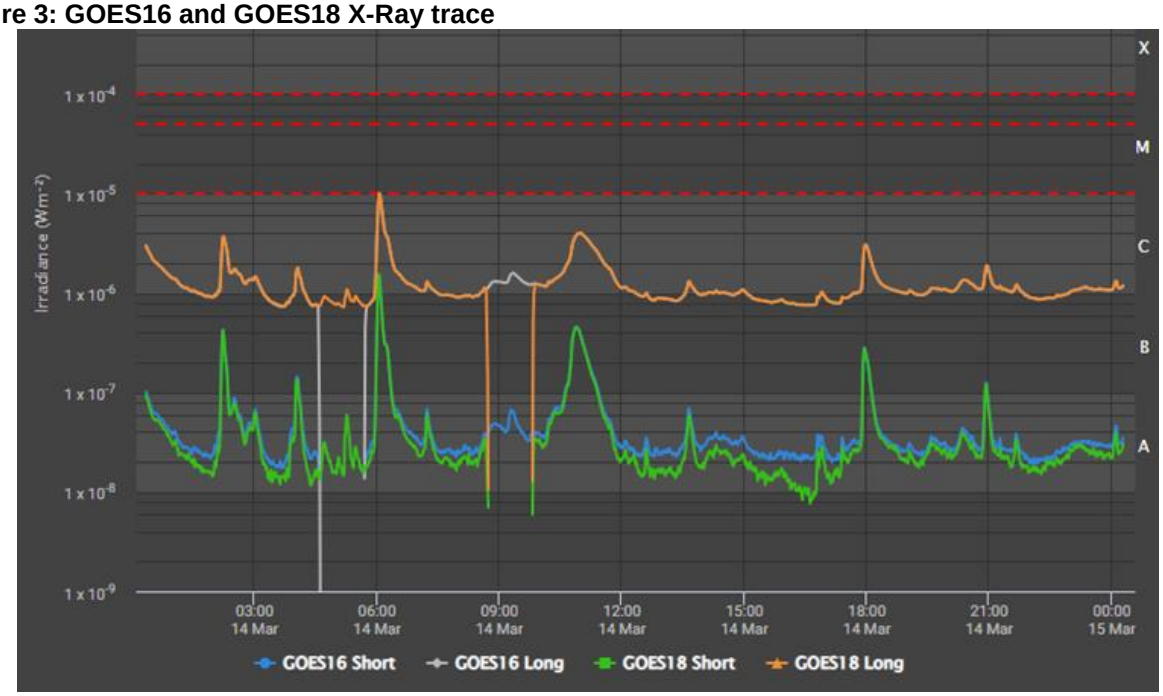
X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	20	10	20	20
Very Active	R3 to R5 X Class	No	1	1	5	5

Figure 3: GOES16 and GOES18 X-Ray trace



Solar Radiation Storms - (High Energy Protons):

With no other sunspots of significance GOES18 proton flux levels are closely tied to activity related to Ex-AR3599. This feature is continuing to rotate away from the visible disc probabilities of S1/Minor Solar Radiation Storms declining by Day 2 (16 Mar).

GOES18 proton flux levels are likely to remain at background throughout.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	5	1	1	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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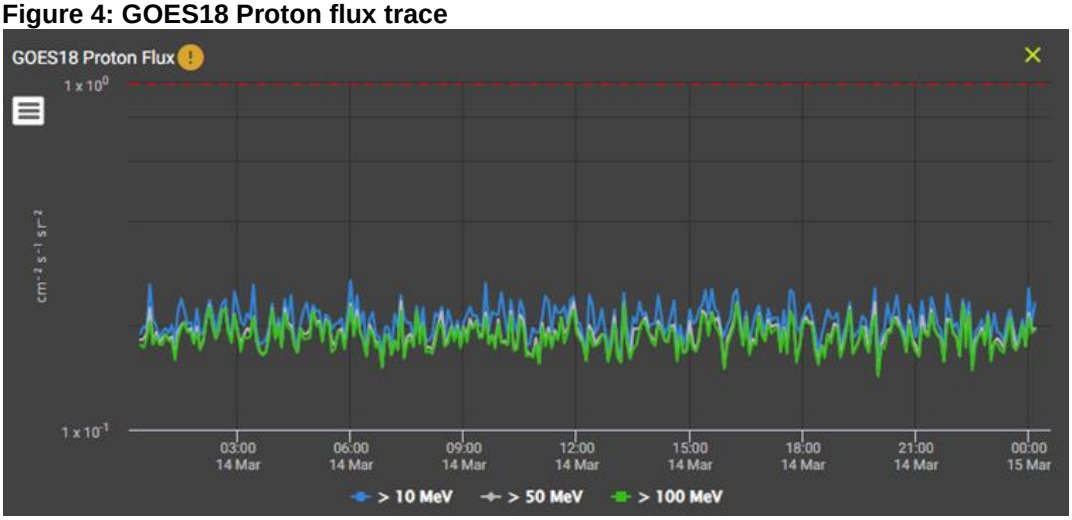
Figure 4: GOES18 Proton flux trace



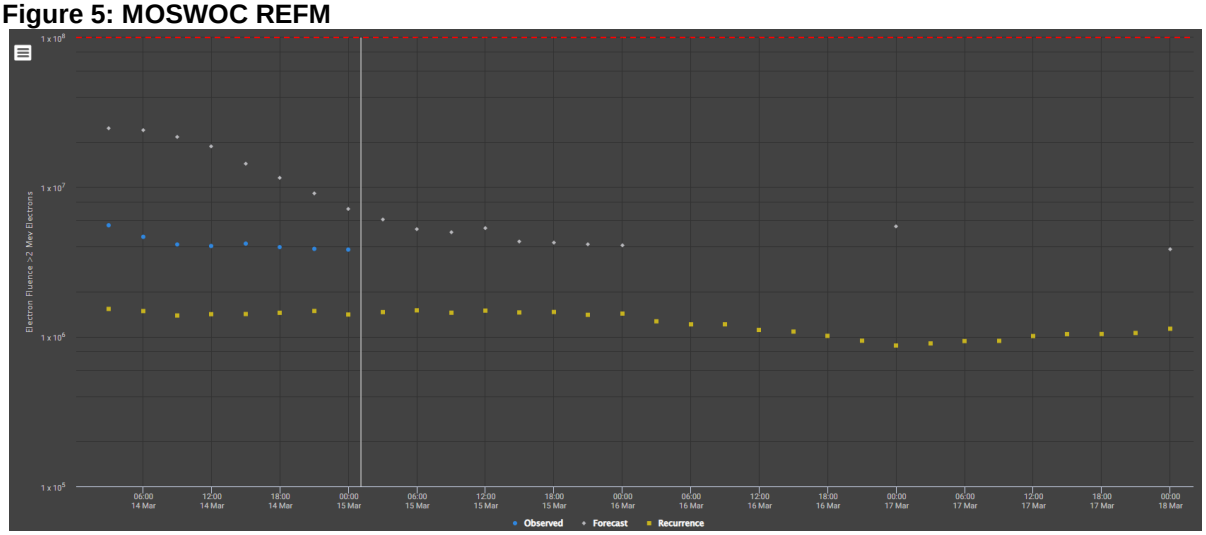
High Energy Electrons Event (≥ 2MeV):

Over recent days the high energy electron flux (greater than 2MeV) has shown a decreasing trend to average at background with diurnal peaks to Moderate levels. Given the absence of any significant enhancement in the forecast, this trend is expected to continue.

The associated 24-hr integrated fluence is expected to remain well below the Active threshold throughout, which is supported by MOSWOC REFM.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	1	1	1
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 5: MOSWOC REFM



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